PM 157

POWER MONITOR

Drwr. E10A

SENCORE

SENCORE SERVICE MANUAL

3200 SENCORE DRIVE, SIOUX FALLS, SOUTH DAKOTA 57107

B/C 07009

SAFETY PRECAUTIONS

When testing electronic equipment, there is always a danger present. Unexpected high voltages can be present at unusual locations in defective equipment. The technician should become familiar with the device that he is working on and observe the following precautions.

1. An isolation transformer should always be used on equipment having the chassis tied to one side of the AC power line.
2. When making test lead connections to high voltage points, remove the power. If this cannot be done, be sure to avoid contact with other equipment or metal objects. Place one hand in your pocket as a safety precaution and stand on an insulated floor to reduce the possibility of shock.
3. Discharge filter capacitors before connecting test leads to them. Capacitors can store a charge that could be dangerous to the technician.
4. Be sure your equipment is in good order. Broken or frayed test leads can be extremely dangerous and can expose the technician to dangerous potentials.
5. Remove the test leads immediately after the test has been completed to reduce the possibility of shock.
6. Do not work alone when working on hazardous circuits. Always have another person close by in case of accident. Remember, even a minor shock can be the cause of a more serious accident, such as falling against the equipment or coming in contact with higher voltages.
7. The PM157 is equipped with a three wire grounded power cord. This ground cord places the case of the PM157 at the same potential as the cold (earth) side of the AC line for your protection. If the PM157 is used in an outlet not equipped with a three wire receiptacal, be sure to maintain proper polarity of the AC line.

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OPERATING INSTRUCTIONS FOR THE SENCORE PM157 POWER MONITOR

DESCRIPTION

The PM157 Power monitor provides for the first time in one package, a meter to accurately measure the AC line voltage, AC line current, and the power supply current flowing through an external circuit. With the PM157 it is possible to determine if a trouble is caused by high or low line voltage, and determine if the circuit breaker of fuse resistor is opening because they are defective or because of a circuit malfunction. With the PM157, you no longer have to be in the dark about power problems.

SPECIFICATIONS

AC Line voltage 115 VAC ±2%
85-135VAC ±3%
AC Current 1A, 3A, 10A ranges (test leads or AC out)
±3% AC RMS or 120 Hz unfiltered DC
AC line power is a function of line voltage. Use table to convert for voltages other than 115 VAC.

CONTROLS ON THE PM157

Range Switch: the range switch is a three position slide switch located just left of center on the PM157 panel. The switch in the upper most position selects the 1A/115W range, the center position of the switch selects the 3A/345W range, and the lowest position selects the 10A/1150W range.

Function switch: The function switch is the center one of the three switches on the panel of the PM157. In the upper position (AMPS WATTS) the PM157 is set up to measure current, either through the test leads or through the AC OUTLET. In the lower (LINE VOLTS) Position the PM157 is set up to measure the line voltage at the AC outlet.

When the function switch is in the LINE VOLTS position, the meter will indicate the line voltage at the AC OUT regardless of the positioning of the other switches on the PM157.

METER Switch: The METER switch operates in conjunction with the AMPS/WATTS position of the FUNCTION switch. The only time that the METER switch has any effect is when the FUNCTION switch is in the AMPS/WATTS position. In the upper (LINE CORD) position, the meter measures the current being drawn by the equipment plugged into the AC OUT. In the lower (TEST LEADS) position, the meter measures the current flowing through the test leads.

OPERATING THE PM157

AC LINE VOLTAGE

1. Plug the PM157 into AC line you wish to measure (do not try and use the test leads to measure voltage)
2. Place the FUNCTION switch in the LINE VOLTS position.
3. Read the line voltage on the uppermost meter scale. The line volts scale is calabrated only from 65 volts to 135 volts because a line voltage below 65 volts will never be found. Each small scale division of the LINE VOLTS scale is 2 volts, so that 110 volts would be exactly half way between the 105 and 115 Volt marker on the meter.

AC LINE CURRENT

1. Plug the PM157 into an AC outlet.
2. RANGE switch to the 10A range.
3. FUNCTION Switch to the AMPS/WATTS position.
4. METER switch to the LINE CORD Position.
5. Plug the equipment to be tested into the AC OUT.
6. Select the range that gives as close to a full scale reading as possible.

The 0 to 1.0 scale is used with the 1A and 10A ranges. Each small scale division is equivalent to .02A on the 1A range and .2A on the 10A range. The 0 to 3.0 scale is used with the 3A range. Each small scale division is equivalent to .1A

AC LINE POWER

The set up for power is the same as for LINES current above. The WATTS scales on the meter are accurate for 115VAC RMS only. For line voltages other than 115V refer to the conversion chart (figure 1A and 1B) to obtain a corrected reading.

The 0 to 115 WATTS scale is used with the 115 and 1150 Watt ranges. Each small scale division is equivalent to 5 watts on the 115 watt range, and 50 watts on the 1150 range.

The 0 to 345 watt scale is used with the 345 watt range. Each small scale division is equivalent to 10 watts.

POWER/VOLTAGE CONVERSION CHART

The conversion charts may be used in two ways:

1. To find the actual power at a line voltage other than 115 volts, find the wattage closest to the measured value in the shaded area marked 115 volts normal. Follow the vertical wattage column until it crosses the horizontal line corresponding to the measured line voltage, and read the correct wattage.

EXAMPLES: line volts 127, measured watts 100. Find 100 watts in the shaded horizontal line labeled 115 volts normal in figure 1A. Starting from 100 watts, follow the vertical column until it crosses the line voltage closest to the measured line voltage. In this case it would be 125 volts. The wattage at this point is 108, so if you measured 100 watts, and the line voltage was 127 volts, the actual power would be close to 110 watts.

2. To find the correct wattage reading for a piece of equipment, when the wattage rating on the equipment is at a different line voltage than measured line voltage, start in the horizontal voltage line that is closest to the voltage at which the equipment's wattage rating was made, and find the rated wattage in this line. Follow the vertical column from the rate wattage, until the column crosses the measured line voltage, and at this point you will find the correct or maximum meter reading for the equipment under test.

EXAMPLE: a light bulb rated at 100 watts 135 volts; line voltage measures 115v. In the 135 volt horizontal line, we find that 100 watts falls almost half way between the 94 and 105 watts. Follow both vertical columns in figure 1A until they cross the 115 volt line. The two numbers here are 80 to 90, so half way between would be 86 watts. This is the approximate wattage the bulb should read at 115 VAC.

TEST LEAD CURRENT

1. Disconnect power from the equipment to be measured.
2. Open the circuit to be measured, and place the test leads on the PM157 in series with the circuit to be measured.
3. Set the PM157 RANGE switch to the 10A position.
4. Set the FUNCTION switch to the AMPS/WATTS position.
5. Set the METER switch to the TEST LEADS position.
6. Apply power to the equipment under test, and set the PM157 range switch to the range that gives as close to a full scale reading as possible.
7. Read the meter scales the same way as in AC line current.

NOTE: when the METER switch is in the TEST LEADS position, the metering circuit is connected to the test leads, and is isolated from the rest of the PM157 circuit. You may use the test leads to measure current when the equipment under test is plugged into the AC OUT of the PM157. When the METER SWITCH is in the LINE CORD position, the test leads are isolated from the rest of the PM157, and no current will flow through the test leads.

LINE VOLTS											
135	35	47	59	70	82	94	105	117	130	135	
130	33.75	45.25	56.75	67.5	79	90.5	101.25	112.75	125	130	
125	32.5	43.5	54.5	65	76	87	97.5	108.5	120	125	
120	31.25	41.75	52.75	62.5	73	83.5	93.75	104.25	115	120	
115	30	40	50	60	70	80	90	100	110	115	NORM
110	28.75	48.25	47.75	57.5	66	76.5	86.25	95.75	105	110	
105	27.5	36.5	45.5	55	64	73	82.5	91.5	100.5	105	
100	26.25	34.75	42.25	52.5	60	69.5	78.75	87.25	95	100	
95	25	33	41	50	57	66	75	83	90	95	

WATTS

Fig. 1A: 0-1 A & 0-10A CONVERSION CHART

LINE VOLTS											
135	105	140	175	210	245	280	315	350	385	405	
130	101	135	199	202	236	270	304	338	371	390	
125	97	130	163	195	227	260	293	325	357	375	
120	94	125	156	188	218	250	282	314	134	360	
115	90	120	150	180	210	240	270	300	330	345	NORM
110	86	115	144	172	202	230	258	288	316	330	
105	83	110	137	165	193	220	247	275	303	315	
100	79	105	131	158	184	210	236	264	289	300	
95	75	100	125	150	175	200	225	250	275	285	

WATTS

Fig. 1B: 0-3 A CONVERSION CHART

FUSEABLE RESISTOR SCALES

The fuseable resistor scales of the PM157 are calabrated based on the typical 5 watt size fuseable resistor. If the fuseable resistor has an actual current rating indicated, it is better to use the current rating rather than the resistance.

1. Connect the test leads of the PM157 across where the fuseable resistor belongs.
2. Follow procedures for measuring test lead current.
3. If the meter indicated in the red area of the scale corresponding to the resistance of the fuseable resistor being tested, then the equipment is drawing more current than it should, and the circuit defect should be located before replacing the fuseable resistor.
4. If the meter indicated in the green area of the scale corresponding to the resistance of the fuseable resistor under test, the current being drawn by the equipment under test is normal, and the fuseable resistor should just be replaced.

NOTE: It is a good idea to check the line voltage at this time. If the line voltage were abnormally low such as on a hot summer day with air conditioners running, the equipment under test may draw excessive current, when the line voltage came back up in the evening.

OVERLOAD PROTECTION

The PM157 is protected in two ways. The meter circuit of the PM157 is protected by a diode. The series standard resistors and the wiring are protected by a 10A circuit breaker located in the lead compartment. This circuit breaker works well to protect the PM157 on over loads of 10 times or more, but on overloads of less than 10 times normal rating, the series standard resistors may become overheated causing them to smoke. This is not serious, as the resistors are quality wire wound types, and will recover from the overloads as long as they are not overloaded for to long a period.

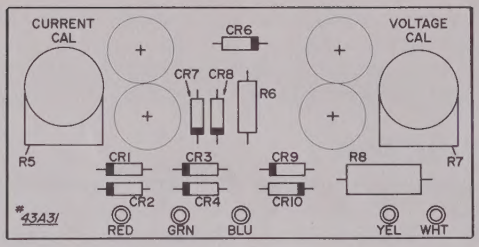
DISASSEMBLY INSTRUCTIONS

1. Remove the four chrome plated philips screws from the front panel of PM157.
2. Pull the front panel of the PM157 away from the case. This will expose enough of the PM157 for most tests and adjustments.
3. If it is necessary to completely remove the PM157 from its case, disconnect the automotive type connectors from the circuit breaker.
4. Open the lead compartment, and pull the plastic strain relief out of the hole where the line cord and test leads enter the PM157.
5. Force the line cord and test leads from the small hole into the big hole through the interconnecting slot.
6. Withdraw the PM157 the rest of the way, guiding the line cord through the large opening in the case.

CALABRATING THE PM157

Calabration procedure must be done in order. (current first, then voltage) Current Calabration: Connect the secondary of a filament transformer rated at least 1A, 5.0 volts; a one ohm 1% resistor of at least 1 watt, and the test leads of the PM157 in series. Connect the primary of the filament transformer to a 0 - 140 volt transformer (varic) with the voltage control adjusted for zero volts. Connect an accurate AC volt meter across the 1 ohm 1% resistor. Set the PM157 up to measure test lead current 1 A range. Adjust the varic until the volt meter connected across the 1 ohm 1% resistor reads 1 volt. Adjust the PM157 current cal control (on the left when viewed from the componant of the PC board.) until the PM157 reads full scale 1A.

Voltage calabration: Plug the PM157 into a 0 - 140 volt varic. Connect a known accurate AC voltmeter to the AC OUT of the PM157. Adjust the varic until the standard meter reads exactly 115 volts. Adjust the PM157 Voltage Cal control (on the right when viewed from the componant side of the P. C. board) until the PM157 indicated 115 volts on the LINE VOLTS scale.



PRINTED CIRCUIT BOARD LAYOUT

CIRCUIT DESCRIPTION

The heart of the PM157 is a one volt full scale volt meter. To measure current, the volt meter is connected across R1, a 1 ohm standard resistor for the 1A range, a 1/3 ohm (R1, R2 & 3) for the 3 A range, and a .1 ohm resistor (R1, R2, R3, and R4) for the 10A range.

To measure line volts, the volt meter is connected across a voltage divider comprised of R8 and R7 the voltage cal control. CR9 and CR10 are on the circuit to provide compression for the low end of the line volts scale. They are silicon diodes and do not start to conduct until the voltage across them is greater than .5 volts.

The RANGE switch S3 selects what parallel combination of resistance (R1-R4) will be used as the series standard resistor.

The METER switch S1 actually switches the series standard resistor. In the LINE CORD position, the standard resistor is connected in series with the AC line, and the test leads are disconnected from the circuit. In the test leads position the standard resistor is connected in series with the test leads, and jumper wire is connected in series with the AC line to maintain continuity.

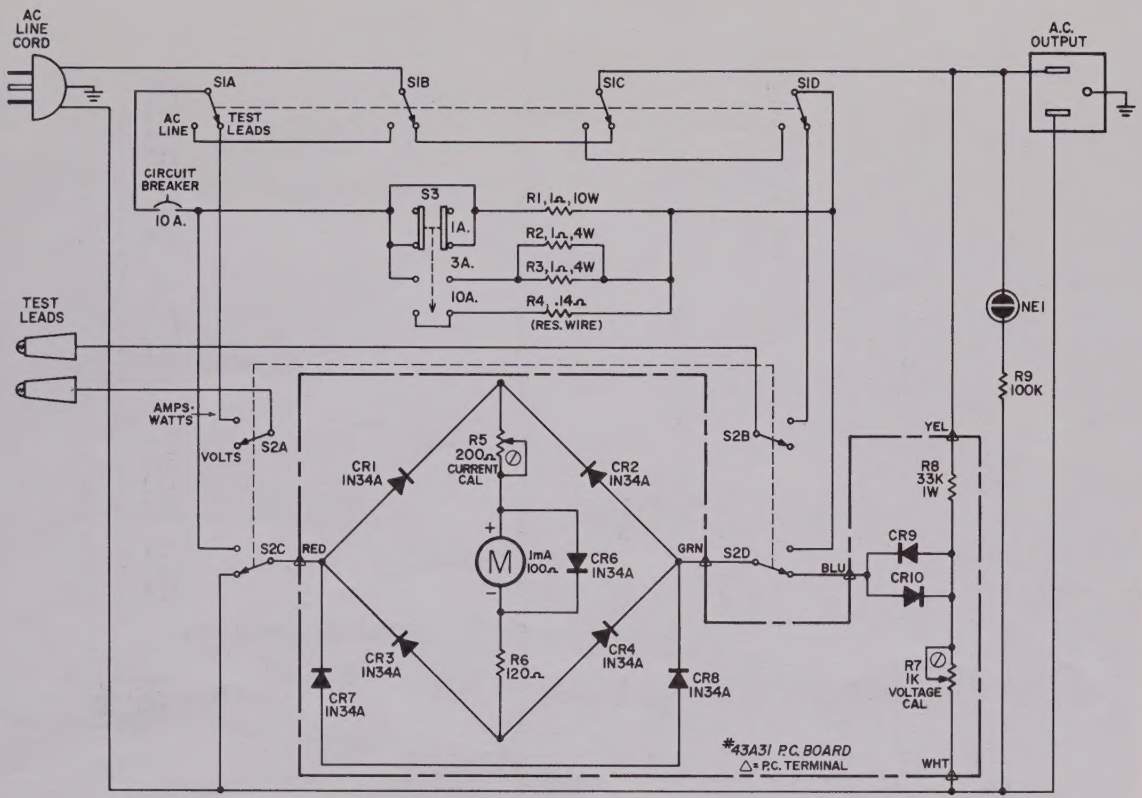
THE FUNCTION switch switches the metering circuit. In the AMPS/WATTS position, the metering circuit is connected across the series standard resistor. In the LINE VOLTS position the metering circuit is connected across R7 the voltage cal control. Extra contacts on the FUNCTION switch S2A & S2B are provided to open the test leads, in the line volts position, so if voltage were accidentally applied to the test leads there would be no damage to either the PM157 or the circuit under test.

TROUBLE CHART

SYMPTON	PROBABLE CAUSE	CORRECTION
in operative in AMPS/ WATTS	open circuit breaker	reset breaker
inoperative all functions	metering circuit componants	replace defect-ive componants
inaccurate on current and voltage functions	current cal control	readjust
inaccurate on voltage only	voltage cal control	readjust
inaccurate on one current range only	series standard resistor for that range	check and re-place if nec-essary

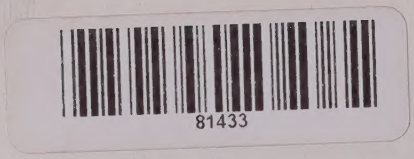
PARTS LIST

REFERENCE NO.	PART NO.	DESCRIPTION	PRICE
R1	14A68-1	Resistor, W.W., 1% 1 ohm 10W	1.75
R2, R3	14A67-1	Resistor, W.W., 1% 1 ohm 4W	1.25
R4	14A69	Resistor, wire-.14 ohm	.75
R5	15C7-19	Trim pot. 30% Horiz. P.C.	.75
R7	15C7-18	Trim pot. 1K 30% Horiz. P.C.	.75
CR1, CR2 CR3, CR4, CR6, CR7, CR8	50C3-1	Diode 1N34A	.50
CR9, CR10	16S10	Diode, silicon	1.50
M	23C39	Meter, 4 1/2"-O-1mA 100 ohms 5%	21.00
S1, S2	25A138	Slide switch, 4P2P	1.00
S3	25A137	Slide switch, 2P3P	.75
NE1	20A7	Neon bulb-red holder	.45
A.C. OUTPUT	26A121	OUTLET, 3-wire A.C.	2.00
Circuit breaker	44A8	10A thermal breaker	3.00



PM157 SCHEMATIC

ISSUE DATE: 6-17-70



SERVICE AND WARRANTY

You have just purchased one of the finest instruments on the market today. The PM157 has been inspected and tested twice at the factory to insure the best quality instrument to you. If something should happen, the PM157 is covered by a standard 90 day warranty as explained on the warranty policy enclosed with your instrument.

For the best service on out of warranty work, send the PM157 directly to the factory service department. Be sure to state the nature of your problem to insure faster service.

If you wish to repair your own PM157, we have included a schematic, parts list, and trouble chart. Any of these parts may be ordered directly from the factory service department.

We reserve the right to examine defective components before an in warranty replacement part is issued.

SENCORE
NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT
3200 SENCORE DRIVE, SIOUX FALLS, SOUTH DAKOTA 57107

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